EU Dairy Quota Reform – AGMEMOD Scenario Analysis

Frederic Chantreuil[1], Trevor Donnellan[2], Myrna van Leeuwen[3], Petra Salamon[4], Andrzej Tabeau[3]
Lubica Bartova[5]

[1] INRA, Rennes, France
[2] Rural Economy Research Centre Teagasc, Ireland
[3] LEI, The Hague, Netherlands
[4] VTI, Braunschweig, Germany
[5] IPTS, Joint Research Centre, Seville Spain

Abstract— **This study provides an in-depth model based quantitative analysis of the implications of the dairy policy reform on the milk and dairy market as well as on other agricultural markets in the EU27, EU15, EU12 and the individual MS. The objectives of the study are threefold:**

1. **to assess the implications of changing policy and market conditions on EU agriculture with special emphasis on milk quota phasing out and export subsidy removal by using a modelling tool;**
2. **to carry out policy relevant scenarios reflecting deregulation (e.g. quota abolition), changes in quota and price levels, different types and levels of direct payments; and**
3. **to analyse the implications of policy reform scenarios and to draw appropriate policy recommendations.**

Based on an overview of the existing approaches used to analyse the dairy market, the necessary adjustments to the AGMEMOD model are developed. Projections are made under a baseline of no policy change for a time horizon of 10 years for selected individual MS, the EU15 in aggregate, EU12 in aggregate (12 MS from May 2004), and the EU27 in aggregate. This baseline is contrasted with a series of scenarios which involve an increase and eventual elimination of the EU milk quota.

The increase in EU milk production under the scenarios is smaller than the increase in milk quota. Milk quota rents fall to zero relatively quickly due to rising input costs and falling milk prices.

However, the milk price path under the scenarios is not hugely different to that of the baseline, so it can be said that the general international market conditions in dairy and animal feed are the main drivers of the observed outcomes. In some MS, expansion potential is quite strong and in such cases production continues to expand even after quotas are removed in those scenarios which involve a larger milk quota expansion in advance of its elimination.

I. INTRODUCTION

Policy reforms such as Agenda 2000 and the MTR have brought about a considerable decline in the market price support for the EU dairy sector, partly compensated by decoupled premia introduced in 2005, which were subsequently incorporated into the Single Farm Payment (SFP). Nevertheless, more amendments are expected to come within the Health Check (HC).

Since the milk quota regime was introduced it has become a scarce production factor, limiting on the one hand, production and the scope for EU exports, but on the other hand stabilising the producer prices of milk. The quota regime allows milk prices to rise above the equilibrium price level of an unregulated market, where prices would otherwise equate with the marginal cost of production. In this way, quota rents are generated. As long as quota rents are positive and the quota quantities are filled, the quota regime is binding. Other things being equal, technical progress in dairy production would lower production costs and lead to an increase in the quota rents over time. On the other hand declining levels of support or increases in the milk quota may reduce producer milk prices, while inflation in production cost items, such as feed grains, may increase costs and hence rents may decrease over time. When declining producer prices or rising production costs reach the equilibrium price, the quota rents will turn to zero and the quota itself will no longer be binding.

One of the consequences of the current shortage of dairy products on international markets has been that the MTR support price reductions have not led to reduced EU dairy commodity prices. Consequently EU producer milk prices have increased, rather than decreased, since 2005. Much of the EU's dairy support measures, like processing aids and export refunds, have been suspended completely in 2007 and 2008, to limit subsidised consumption and exports and ensure sufficient commercial supply for the domestic market.

Against this background an end to the EU milk quota system is inevitable and the manner in which the phasing out will be managed becomes important. The necessary policy changes should aim to minimise market instability arising from the ending of the milk quota regime. The simplification of the CMO for milk and dairy products and the changing economic environment, will have impacts – and not just on the milk and dairy market. Against the background of a dynamic economic environment and an ever changing CAP, the ex-ante policy implications for the EU agricultural markets shall be analysed in this report. To take all the various parameters into account, a modelling approach is required.

II. LITERATURE

For the modelling of quota abolition and other milk and dairy market reforms such as changing trade regimes, the most common approaches used are CGE models, PE models, programming models and econometric estimations of cost functions. Such assessments are often based on a combination of these different approaches (Isermeyer et al, 2006 [1] Kleinhanss et al, 2002 [2]; Colman, 2002 [3]; Bouamra-Mechemache et al., 2002 [4]). Generally, either a type of shadow price supply function is applied exogenously to a PE or CGE model or else milk price vectors are provided exogenously in the case of programming models.

Since the prospect of an extension or elimination of the milk quota system has arisen during discussions on previous CAP reforms, there is a body of study which has addressed the topic of the impacts of its abolition. A wide variety of contributions were made in advance of the previous reforms to shed some light on the issue. Most of the research was model-based, but some

also encompassed different approaches (Colman 1998 [5], 2002 [3]; Commission of the European Communities, 2002 [6]; Helming et al., 2002 [7]; Hennessy et al., 2000 [8]; Jansson and Britz, 2002 [9]; Kleinhanss et al., 2002 [2]; Lips et al., 2002 [10]; Lips et al., 2005 [11]; Van Tongeren, 2002 [12], Westhoff and Young, 1999 [13]). An overview of these studies can be found in Salamon (2002) [14]. Since then, some of these studies have been revised and extended notably (Bouamra-Mechemache and Requillart, 2006[15]; Helming, 2005 [16]); Van Berkum and Helming, 2006 [17]; Hennessy, 2007 [18]; Binfield et al., 2007 [19]; Isermeyer et al., 2006 [1]; Requillart et al, 2008 [20]). Other studies are in preparation or have yet to be published.

Various models which differ significantly have been employed to model quota abolition. Often several models are operated in unison to enable an in-depth analysis, most notably where commodity market level models and farm level models are applied to the analysis of a common set of scenarios. Studies simulating quota abolition have drawn on CGE models (Lips et al., 2002 [9]; Lips et al., 2005 [10]; Van Tongeren, 2002 [11]; Isermeyer et al., 2006 [1]).

PE models covering either the whole agricultural sector (Kleinhanss et al., 2002[2]; Jansson and Britz, 2002 [8];) or focussing exclusively on the dairy sector (Kleinhanss et al., 2002 [2]; Bouamra-Mechemache et al., 2002 [4]), econometric supply models (Bouamra-Mechemache et al., 2002 [4]; Bouamra-Mechemache and Requillart, 2006 [14];), various types of (regional) programming models (Helming, 2005 [15]); Van Berkum and Helming, 2006 [14]; Kleinhanss et al., 2002 [2];; Isermeyer, et. al., 2006 [1]; Colman et al., 2002 [3]; Jansson and Britz, 2002 [8]) and expert based simulation models (Kleinhanss et al., 2002 [2]).

PE models have the ability to incorporate greater amounts of details on production and policy instruments, they have advantages over their CGE counterparts (Salvatici et al, 2001 [21]). Generally, PE models describe one sector or a group of closely related products in an economy with a greater level of disaggregation than is common in CGE models. Given the capacity of PE models to incorporate detailed representations of relationships between policy instruments and agricultural commodity supply and demand, this type of model is very suitable to the

analysis of the agricultural sector of developed economies. The PE framework also facilitates the coverage of more detailed products. Important features of the PE model grouping are their relatively simple economic structure, and their easily understandable and interpretable results. This last feature can be advantageous when model results are used by non-economists. A more detailed overview on general and partial equilibrium models and their different features is to be found in Van Tongeren et al. (2001) [22]..

PE models applied to the analysis of quota abolition generally cover the whole agricultural sector (Kleinhanss et al., 2002 [2], Jansson and Britz, 2002 [8]; Binfield et al., 2007 [19]), but some only focus on the dairy sector; Bouamra-Mechemache and Réquillart, 2006 [15]; Kleinhanss et al., 2002 [2], Réquillart et al. 2008 [20]). Consequently, such models vary with respect to product coverage and policy implementation. Furthermore, base years and databases differ. Apart from the FAPRI-Ireland model, which largely uses national data sources, nearly all models draw most of their information from NewCronos (EUROSTAT database), but these are often supplemented by other national statistics. A common feature in most studies is the multi-level approach including raw milk production, processing of dairy products and demand for dairy products; Bouamra-Mechemache and Réquillart, 2006 [14], Kleinhanss et al., 2002 [2]; Jansson and Britz, 2002 [9]). It seems to be difficult to estimate production functions based on time series data in order to model quota abolition in a PE framework. Since its introduction in 1984, all estimates will reflect the existence of the milk quota. Hence, additional information is generated by production and farm models and directly or indirectly applied to the PE models. With respect to the processing sector, available milk is often broken down into fat and protein components thus enabling fat and protein to be considered as the inputs for the production of the different dairy products rather than just raw milk.

A detailed spatial PE model (INRADM) was employed by a Commission study (Commission of the European Communities, 2002) [6] examining the vertical impact from milk supply, down through milk processing and into the demand for final dairy products. Within this approach total milk supplies and

usages were divided into fat and protein and processing technologies were explicitly modelled. The model considered 14 final dairy products. At that time, the results of the individual EU14 MS, four additional regions and imports from an aggregate 'rest of the world' (ROW) were represented. Demand developments were captured by annual shifts in demand functions. Additionally, a production model based on a dual short-run profit and netput function depicting the raw milk and beef production was applied. Production in the context of quota abolition was handled through interaction with a production model in which the quota restrictions were removed.

In Kleinhanss et al. (2002) [2], two different PE models were applied. Firstly, GAPsi (a multi-product, multi-regional model) generated the equilibrium prices needed by the different supply models. In terms of regional aggregation, individual EU MS and the 'ROW' were covered. Under the consideration of available information on quota rents and expert knowledge a production function was constructed applicable for the quota abolition. Secondly, the PE model MIPsi was employed specifically to simulate the effects of alternative EU milk policies. Maintaining the same regional aggregation as GAPsi, MIPsi comprises a completely different product structure, with raw milk processed into five dairy products (fresh milk, butter, cheese, milk powder, other products) each consisting of price-dependent quantities of fat, protein and other inputs including value added. Intervention prices for butter and SMP as well as WTO restrictions concerning individual products can be implemented in the model directly.

The study by Binfield et al. (2007) [19]; is in some respects a follow-up on the study by Westhoff and Young (1999) [13]. The earlier study had been based on the standard FAPRI model, while the more recent study employed the FAPRI GOLD and FAPRI-Ireland models. The 2007 study is characterised by an enhanced representation of the Irish agriculture sector. The general design of the FAPRI-GOLD and FAPRI-Ireland models is a PE, multi-market model, organised along commodity lines with EU MS or EU regional modules. Depending on data availability, most MS and regional modules contain equations for five commodities: milk, butter, cheese, non-fat dry milk, and WMP. Price and quantity variables are passed

between the dairy model and the other FAPRI commodity models to accommodate interactions. The dairy model solves for equilibrium in international markets for the four derived products, and a domestic equilibrium for fluid milk is maintained at all times. Reflecting the structure of these models, quota abolition is simulated by quota expansion until the quota is no longer binding.

III. METHODOLOGY

A. *Model Design*

The AGMEMOD model used in this study is an econometric, dynamic, multi-product PE model wherein a bottom-up approach is used. Based on a set of commodity specific model templates, country specific models were developed to reflect the detail of agriculture at MS level and at the same time allow for their combination in an EU model. Such an approach should capture the inherent heterogeneity of the agricultural systems existing across the EU, while the analytical consistency across the country models will be hold via a close adherence to templates. The maintenance of analytical consistency across the country models is essential for the aggregation towards an EU level, and also it facilitates the meaningful comparison of the impact of a policy change across different MS.

Within the 6th Framework Program, the AGMEMOD model Version 1.0 has been turned into an EU combined model that comprises all Member States. Version 2.0 can be characterised by:

- transparent input–model–output structure;
- consistent and harmonised use of mnemonics, data and assumptions across countries;
- memory efficient use of variables;
- ease of extension to new commodities;
- ease of extension to new countries.

Further, the AGMEMOD Version 2.0 takes account of data and parameter up-dates up to the year 2020 for all MS, although the work on validating and revising

of the country model outcomes is an ongoing process and will continue right through 2008.

Also, in the first half of 2008 the milk and dairy product sector in AGMEMOD has been revised in order to assess the objectives of this dairy study. As a result, the dairy sub-model structure in the AGMEMOD Version 2.0 changed significantly compared to the approach applied in Version 1 (Chantreuil et al, 2005) [24].

The various domestic commodity markets are linked to each other by substitution or complementary parameters on the supply or demand side. The basic linkages covered in the model are represented in Figure 1. Interactions between the crops and livestock sub-models are captured via the derived demand for calves and feed. The supply and utilisation balance is ensured via a closure variable. The choice of the closure variable may differ between one commodity sub-model and another and between one country and another. However, for most countries, the closure variable of the commodity markets is usually the exports variable. In general, sub-models capture supply, imports, exports, human and feed consumption, stocks and price relationships. These sub-models also cover a detailed set of agricultural policy instruments in each MS. Hence, the AGMEMOD Version 2.0 allows for the generation of projections and scenario simulation results for each individual MS.

To complete the building of the AGMEMOD sub-models tool for each of the commodities, it is necessary to add an equation that describes the equilibrium for each commodity market at both the MS and EU levels. This condition implies that production plus beginning stocks plus imports will be equal to domestic use plus ending stocks plus exports. In a closed economy, this supply and use equilibrium condition is sufficient to determine the equilibrium country market prices endogenously. Given that the EU does not represent a closed economy, the Rest of the World can have important impacts on the economy modelled. To account for such impacts, price linkage equations are used, to represent the inter-relationship between MS, and between the EU and the Rest of the World.
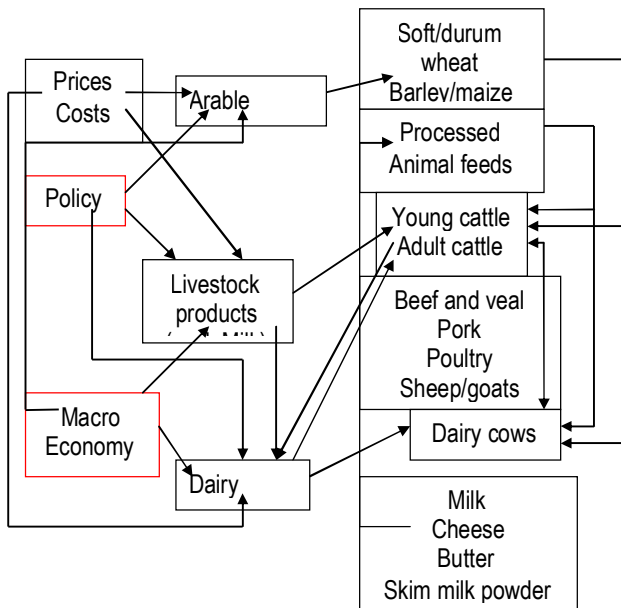
Fig:1: Linkages between commodity markets in the
AGMEMOD model

For each commodity market and for each country, the functional representation that is actually used can vary. In principle, such deviations from the template can be made by all country research teams. These deviations from the template are due to the requirement that the country level model should capture distinct market features at MS level. Where data limitations exist, the final functional forms are adjusted in response to the statistical and economic validation of the models. It should be noted that all the country models are under continuous revision, but the principles of the country-specific specifications can be found in e.g. von Ledebur et al. (2005) [25], Chantreuil and Levert (2005) [24], Esposti and Lobianco (2005) [26], and van Leeuwen and Tabeau (2005) [27].

B. Data Sources

To enhance the AGMEMOD model for further use in policy analysis requires the maintenance and updating of datasets that are internally consistent and coherent. Each country model is based on an aligned database of annual time series of agricultural commodity supply as well as of market balance sheets and price data related to the respective commodities

modelled. Originally, the sample covered a period from 1970 to the latest available year, which, depending on the country concerned, ranges from 2002 up to 2006.

Data for each country and the aggregates for the EU are to be found on the AGMEMOD website (http://www.agmemod.org). The AGMEMOD data report (Chantreuil and Levert, 2007) [28] provides an overview of historical MS level dairy market developments. Due to constant up-dating, the latest version will always be accommodated within the combined model situated on the AGMEMOD2020 FP6 project website.

The AGMEMOD model's database is itself composed in part of balance sheets for all commodities, generally detailing opening stocks, production, imports, human food consumption, feed use, processing and industrial use, exports, and ending stocks. Where possible the AGMEMOD Partnership uses Eurostat sources such as AgrIS (Agricultural Information System) and NewCronos, as these meet the above mentioned criteria. Ideally, all data would be drawn from the same database. In practice, however, databases may be incomplete or inconsistent or may show different numbers for the same variables in a given year or they may include definitions which are unclear. Gaps range from the absence of a data point in a series to the total absence of data for the series in one or more countries. Where there are such gaps, the recommendation is to derive comparable data from other international sources like FAO or USDA, and in particular, national sources, or, failing these options, to use interpolations based on statistical techniques or expert judgement.

In all instances data sources are made available to all partners so that they can be subject to review and that discrepancies can be detected. Nevertheless, each partner is required to check the commodity datasets assembled in order to ensure that for all commodity markets and for all years of the sample time period the market the supply and use balance holds. In those cases where the supply and use do not balance, adjustments are to be made so that the balance will hold for all commodities and in all years.

Eurostat data, as well as data from other databases, are subject to frequent revisions. These revisions might not only affect the previous year's observation

but may also extend over longer period such as a decade. Where these amendments are not taken into account through re-estimations, the model results will not reflect such changes in the database. Within this project a limited number of the most relevant equations e.g. milk production, yield, and key prices are re-estimated.

In addition, the results obtained by this econometrically estimated partial equilibrium model, relies on detailed historical policy data. A dataset capturing the evolution of CAP policy instruments in the period 1970 to 2004 contains data on variables such as direct payment instruments and support prices associated with the commodity market organisations that collectively make up the CAP. In first instance this EU policy dataset is used for the estimation of the MS level models, but in particular it is required for the simulations.

Another key dataset in the model covers macroeconomic data which was required for the empirical estimation of the country model equations and for the simulations in the projection period. Historical data on macroeconomic variables like inflation, per capita economic growth, and currency exchange rates have been assembled.

Historically, the EU net trade situation for the bulk of the commodity markets considered has been stable. The EU is a net exporter for wheat, barley, pig meat, poultry meat, cheese, skim milk powder, butter and whole milk powder and a net importer for maize, sunflower seed, soybean and sheep meat. For the remaining commodity markets, the net trade situation has varied over the historical period. After a long period as a net importer, the EU has become a net exporter for rapeseeds, while the reverse is the case for beef and veal, where the EU became a net importer in the early years of this decade.

Values for the world market price projections are obtained from the FAPRI modelling system, which has a broadly similar structure to the AGMEMOD model. This allows for the incorporation of the impact of global supply and demand developments on EU agricultural markets.

Macroeconomic data are needed to generate baseline projections for the main agricultural commodities in the EU MS. Historical data on macroeconomic variables like population, inflation,

per capita economic growth and currency exchange rates have been assembled at the country level. In order to conduct simulations and to generate projections from 2006 to 2020, exogenous projections for the development of the macroeconomic variables were also needed. and mostly obtained from the national statistical services in the MS.

Exchange rate projections, including the euro exchange rate with the US dollar, are sourced from internationally recognised macroeconomic forecasters. For non-Eurozone countries, the exchange rate between these national currencies and the US dollar is derived from their exchange rate with the euro and the baseline US dollar/euro exchange rate. The assumptions on the evolution of the US dollar/euro exchange rate are based on the observed exchange rate for 2007 and the percentage change in this exchange rate that are published by FAPRI 2008.

C. Milk Production Model Characteristics

Each MS model within the AGMEMOD model Version 2.0 captures the milk and dairy product market. The projections of milk and dairy products are conditioned by the presence of the milk quota. For this study, the dairy model is amended in order to make AGMEMOD useful for simulating the dairy market development over the quota expansion and quota-free periods. Thus dairy model structure in AGMEMOD has been improved with an enhanced milk supply function.

Milk production is modelled as a function of the quota level and the ratio between milk price and milk production costs, represented by a milk production cost index i.e.

$$spr_t = f\left(qua_t, pwn_t / ici_t\right) \qquad (1)$$

where spr_t is the cow milk production in year t, pwn_t is the price of milk in year t, ici_t is the milk production cost index, qua_t is the exogenous milk quota in year t allocated to the country concerned.

This equation implies that producers will adjust their milk production according to changes of the milk quota. The pwn_t / ici_t variable means that changes in the profitability of milk production influence the producer decisions to under-fill or overfill the quota.

Where milk production profitability is high, producers may overfill quota as an "insurance policy" to ensure that quotas will be filled; whereas in the case of low milk prices they may decide to under-fill the quota to avoid any over-quota milk production and the paying of any super-levy. Equation (1) is estimated or calibrated using historical data.

However, the milk production equation (1) can not properly explain the consequences of more fundamental dairy policy reforms. For example, in practice, a sufficiently sharp reduction in support prices would result in a substantial under-fill of the quota. However, that effect can not be captured by the milk supply function specified above (Equation 1).

A similar problem would arise when the milk price would decrease due to a quota expansion. In recent years and in some MS, milk policy reforms - mainly due to intervention support price reductions - resulted in a situation where the milk quota was no longer binding. Thus, a quota expansion will not inevitably be transformed into a production increase across all MS. In particular the quota was not binding in MS where prices were below the EU average levels over a succession of years. On the other hand, over the last ten years with particularly high prices, the milk quotas had been exceeded in other MS.

To model this phenomenon and to take account of the expected dairy policy reforms that would lead to significant changes in the milk productivity and milk quota rents, the milk production function in AGMEMOD is extended.

Under *quota abolition*, the main factor explaining the level of milk production is the profitability of production, which can be proxied by the price-cost ratio and the quota rents. Milk quota abolition is expected to accelerate structural changes in the dairy sector and this will lead to an increase in efficiency.

Efficiency gains have occurred under the milk quota regime, but their effect has been to decrease production cost per unit and to increase quota rents. The estimation of production costs based on farm account data is a considerable task and time series for costs or rents are mostly unavailable. Therefore, the yield per cow is partly incorporated in the milk supply equation and used as a proxy for efficiency gains. As a result, the milk production equation under quota

abolition in AGMEMOD Version 2.0 has the following specification:

$$spr_t^{non-quo} = f\left(pwn_t / ict_t, ypc_t\right) \qquad (2)$$

where $spr_t^{non-quo}$ is the milk production under the non-quota regime in year t, ict_t is the milk production cost in year t and ypc_t is the milk yield per cow in year t.

From 1984 onwards, the milk quota regime exerted its influence over milk production, processing, consumption and trade for EU15. Hence, an econometric approach based on estimates derived from historical data will not generate the correct effects of the policy switch that has been envisaged for dairy in the future. For this reason, the production function (Equation 2) is calibrated based on country-specific data on milk production costs and quota rents. In the model this leads to a milk production increase when the quota is abolished and the quota rents disappear -except in those cases in which the quota has already declined to zero.

Similarly, a synthetic production function needs to be applied in the EU12 AGMEMOD country models. Historical data observations for the countries that have acceded the EU since January 2004, mostly concern the non-quota period and thus describe a situation in which milk had been produced under typical - pre-accession - agricultural policy circumstances. As that policy situation was quite different from the current and likely future dairy policy environment in the EU12, the production equation (2) will also be implemented according to a synthetic approach. For both the EU15 and EU12 models, the calibration procedure applied in AGMEMOD Version 2.0 is described later.

Prior to the milk quota abolition in 2015, a gradual quota expansion period is envisaged. Potential significant reductions in the profitability of milk production due to lower milk prices and/or cost increases and associated falls in the milk quota rents to zero will mean that the milk production equation (2) – used under the quota regime - will not be valid. In this case, the farmer's behaviour is explained by the supply function used in the case of quota abolition. On the other hand, quota expansion can still remain binding

so that the production function used under the quota system is valid. Thus, both types of milk supply functions are applied for the quota expansion years and it is assumed that the lowest production level will determine projected milk production in each MS.

Finally, the milk production equation over the whole modelling period in the AGMEMOD Version 2.0 can be presented by combining the equations (Equation 1) and (Equation 2):

$$spr_t = f(qua_t, pwn_t / ici_t) \cdot quo + spr_t^{non-quo} \cdot nquo +$$
$$+ \min(f(qua_t, pwn_t / ici_t), spr_t^{non-quo}) \cdot (1 - quo - nquo)$$
$$(3)$$

where quo is a dummy for the milk quota period and $nquo$ for the quota abolition period.

Analogous to other PE approaches AGMEMOD requires the implementation of an explicit production function for each MS to simulate milk production under the condition that no milk quota is applied. Within the AGMEMOD model system such a function is set-up synthetically.

The actual milk supply function to be incorporated into the AGMEMOD system needs to take several aspects into consideration. The most important features of the approach are:

- the need to adopt synthetic milk supply functions for each MS, given that parameters could not be estimated based on MS time series data generated under milk quota conditions;
- to incorporate external information on estimated country-specific quota rents (or more specifically marginal costs of production). Where rents are positive in the year of quota abolition an expansion in production will take place. On the other hand if the quota rents are zero or negative no supply expansion is anticipated and the milk production will follow a price/cost driven function;
- the information on milk quota rents employed for all MS have to be generated consistently across all MS, where available;
- that initial quota rents are adjusted over time by applying milk prices and production cost changes occurring from the period for which the rents have been estimated up to the present. In turn projected levels for the rents are derived by projecting the future level of milk prices and milk production costs. The projected evolution of rents must reflect

the anticipated variation in the way that feeding costs or opportunity costs change over time across the MS. Thus, it is important to consider heterogeneity in dairy production systems and the extent to which a comparative advantage exists in dairying over other forms of agricultural production;

- the function will lead to an increase in production when the price/cost ratio is increased and vice versa.

This study uses the following country-specific linear functions as a proxy of the milk supply function under quota abolition.

$$spr_t^{non-quo} = \alpha \ pwn_t / icta_t + \beta \qquad (4)$$

where α (>0), β are unknown parameters and $icta_t$ is an adjusted production cost variable in year t. The adjusted production cost variable reflects the endogenous milk production cost index, which is adjusted for productivity gains due to an ongoing technical progress. The rate of increase in the milk yield per cow is used as proxy for technical progress:

$$icta_t = ict_t \ (1 - \lambda \ gypc)^{(t-t_0)} \qquad (5)$$

where t_0 is the calibration year, gypc is the annual increase of milk yield per cow and λ is a scaling parameter (yield correction coefficient) for the milk yield to indicate the extent that yields can contribute to lower production costs.

This approach with the yield correction coefficient is necessary since the AGMEMOD Version 1.0 used only feeding costs and the GDP-deflator as a proxy for total costs. Other cost items may not be subject to similar rates of change, e.g. grass forage. More importantly, these cost structures reflect changes in the input prices without taking account of changes in the volume of input utilisation, and, as a result, the cost savings that accrue through technical progress. The yield correction coefficient in AGMEMOD version 2.0 is assumed to be 0.5, which indicates that 50% of the yield increase results in a cost reducing effect. In some countries, however, this value was adjusted if the model projected negative rents through the historical period, even through the milk quota was actually filled in the years concerned or in the case where technical progress could be higher or lower, according to country experts. In such cases the evolution of rents is projected and the value of the

yield correction coefficient is increased or decreased accordingly relative to the default value.

The following modified version is used to calibrate equation (4) for the year 2000:

$$spr_t^{2000} = \alpha \ (pwn_t - rent)/icta_t + \beta \qquad (6)$$

where rent is the quota rent (euro/100 kg) in the calibration year 2000. When the quota rent is positive, then the milk production calculated from equation (4) should be equal to the milk quota. A distinction is drawn here between year on year production variations caused by factors such as unfavourable weather conditions or administrative restrictions related to the operation of the milk quota system in the MS concerned. When milk quota are abolished, the quota rent will be set to zero, and thus, equation (6) is reduced to equation (4) in which the milk production will increase by at a positive value for the quota rent.

Equation (4) has been calibrated to the milk production levels in 2000 on the basis of equation (6). Depending on the MS production level, the parameter α is set to obtain an output increase ranging from 0% when the quota rent (as % of the milk price) is 0, up to 30% when the quota rent (as % of the milk price) is about 35 (rent as % of the milk price).

The elasticity between the milk supply and the milk price/cost ratio is equal to 0.5 when the quota rent is 0, it is about 0.78 when the quota rent is 35 and it equals 1.00 when the quota rent is 50. As the quota rents are between 0 and 36, the resultant elasticities range between 0.50 and 0.85 in 2000 (Table 1).

Compared to these results, studies on the pre-milk quota period in the 1980s showed stronger supply reactions to changes in the price/cost ratio (see Kersten and Salamon, 1985). However, administrative regulations have been intensified in the meantime and hence will dampen the scope for production increase.

An additional obstacle is that the system of national quota implementation across countries is quite diverse, particularly when it comes to the edge of quota transfer. Unfortunately, these variations could have had major impacts on the efficiency of the milk supply. Examples in this context are Ireland, but also France. Furthermore, expert reviewers rejected the possibility of higher increases than derived here. For some of the country AGMEMOD models, the milk production equations have been calibrated to fit with results of regional or farm supply models e.g. for the Netherlands, Germany, Ireland (RAUMIS, FARMIS, FAPRI-Ireland Farm Model). The parameter β was then applied to reproduce the level of milk production in 2000.

Table 1: EU Member State supply elasticity (index) in respect to milk price/cost ratio, 2000

Country	Index	Country	Index
Belgium	0.76	Sweden	0.59
Denmark	0.55	United Kingdom	0.60
Germany	0.63	Lithuania	0.50
Greece	0.57	Slovenia	0.50
Spain	0.71	Latvia	0.54
France	0.59	Bulgaria	0.50
Ireland	0.77	Czech Republic	0.16
Italy	0.83	Estonia	0.50
Netherlands	0.78	Hungary	0.56
Austria	0.75	Poland	0.54
Portugal	0.55	Romania	0.50
Finland	0.52	Slovak Republic	0.50

Source: own calculation

To calibrate the milk production equation (4), the necessary country-specific quota rents (as a percentage of the producer milk price) and milk production cost data have been generated. For the EU15, these rents were calculated using the actual fat content producer (raw) milk price from NewCronos (EUROSTAT), whereas the marginal milk production costs came from Réquillart et al (2008) [20]. For EU12, Réquillart et al provides quota (lease) prices and these are used to approximate the quota rents. This has been done by taking 10% of the quota price – assuming a ten years depreciation of the quota buying-in price – and dividing this by the producer milk price. Table 2 present the country based quota rents in 2000.

The resultant quota rents (Table 2) and milk prices are use to calculate the milk production cost and quota rents in 2000 in the AGMEMOD model.

While the calculated production cost reflect the economic situation in the year 2000, these production costs must be projected into the future to provide an annual milk production cost index. This production cost index is presumed to vary in accordance with changes in feed cost - proxied by feed prices - and other input costs - proxied by the GDP deflator.

Table 2: EU Member State milk quota rents (as % of the producer milk price) in 2000

Country	%	Country	%
Belgium	34.3	Sweden	15.0
Denmark	8.8	United Kingdom	15.8
Germany	20.2	Lithuania	0.0
Greece	12.7	Slovenia	0.0
Spain	29.5	Latvia	8.9
France	15.1	Bulgaria	0.0
Ireland	35.0	Czech Republic	3.0
Italy	9.7	Estonia	0.0
Netherlands	36.0	Hungary	3.0
Austria	33.4	Poland	8.0
Portugal	8.6	Romania	0.0
Finland	4.0	Slovak Republic	0.0

Source: own calculation based on NewCronos EUROSTAT and Réquillart et al. (2008).

Generally the share of the impact of the feeding cost was set to 30%, but country-wise the shares were adjusted on the basis of information from national experts.

However, this share may under-estimate the impact of the feeding and energy costs since, the opportunity costs for land and labour are affected also. To capture the impact of technical progress on production cost in the simulation period, the costs are adjusted according to equation (5). Fifty percent of this technical progress is assumed to have a cost saving progress. The rate for the milk per cow production growth has been calculated from the AGMEMOD database.

IV. BASELINE & SCENARIOS DESCRIPTIONS

Given the upheaval in commodity markets in 2007 and 2008, an exact description of the baseline policy in advance of undertaking the analysis is not possible. To a degree, it is an empirical question which is dependent on the strength of international markets and the extent to which this might condition the EU Commission's decisions with respect to intervention, export refunds and subsidised domestic consumption. Taking this point into account, the baseline in this study has been developed as follows:

- milk quotas remain in place at the 2008/09 level throughout the projection period

- 2008/09 quota expansion package (the 2% milk quota increase) has been implemented
- butter and SMP intervention remains in place throughout the projection period
- no further WTO reform occurs and the URAA conditions hold
- export subsidies and import tariffs remain 'on the books' and are used when required to support the producer milk price

The main issue for the scenarios will be the pace of quota reform, whether it takes place rapidly in a short number of years (i.e. over 1 or 2 years) or whether it takes place more slowly (over 3, 4, 5 or 6 years).

It seems highly unlikely that quota removal would be accompanied by any additional compensation for the resultant decrease in price, so no compensation will be assumed. Alteration of other policy levers in order to create a coherent set of policies for the dairy CMO as quotas are relaxed is a possibility. For example, it might be required that quota removal is accompanied by further reductions in the intervention price for dairy products, in order to prevent stock-building as dairy commodity prices decrease. This is particularly the case for butter more so than SMP, given that the internal EU butter price is ordinarily substantially above the world butter price, whereas in the case of SMP the world and EU prices have been much closer to each other in recent years. Reform of the butter intervention price would also help adjust the butter/protein price ratio in the EU and bring the ratio closer to that prevailing on international markets. Intervention price reductions and the elimination of export subsidies would be seen as important steps toward aligning EU dairy policy to cope with WTO reform. Taking the foregoing into consideration the following four scenarios have been developed for analysis.

Scenario Milk 1:
- The dairy quota is expanded by 1% each year from 2009/10 to 2013/14;
- 2009/10 is year 1 (total increase 5% by 2013);
- Milk quota is eliminated in 2015;
- No compensation is paid to producers for the resulting price drop.

Scenario Milk 2: As Scenario Milk 1 but
- The dairy quota is expanded by 2% each year 2009/10 to 2013/14

Scenario Milk 3: As Scenario Milk 1 plus:
- Butter intervention prices will be reduced by -2% per year starting in 2009

Scenario Milk 4: As Scenario Milk 2 plus:
- Butter and skimmed milk intervention prices will be reduced by -2% per year starting in 2009;
- Dairy subsidised export limits are reduced by -5% per year starting in 2009

V. RESULTS

A. Baseline

The most notable feature of the projections is the contrast between historical and projected future prices. World prices for dairy products are projected to average over 1,000 US$ higher than in the reference period, relative to earlier in this decade. It can be expected that world dairy product prices will decline considerably from the, albeit exceptional, levels achieved in 2007. Normal weather and higher prices should boost global production and bring about these price declines. However, although international prices are expected to decline beyond 2008/2009, the international price outlooks are much higher than had been projected in earlier years. Baseline projections for the EU27 dairy market are presented in Table 3.

In broad terms the baseline reflects a relatively static level of milk production for the EU 27, with the exception of the increase in production arising from the expansion in milk quota as part of the 2008 quota expansion package (the 2% EU milk quota increase agreed for 2008/09 onwards). When measured against the 2007 level of EU milk production, which was below the 2007/08 EU milk quota level, the increase in milk production by 2020 is projected to be 1%.

The increase in butterfat content over the projection period requires an offsetting decrease in deliveries to reflect the butterfat adjustment, so a full 2% increase in the volume of milk for processing would not be possible.

Table 3: Baseline Projections for EU27 Milk and Dairy Sector in selected years

		2005	2010	2015	2020
Cow milk					
Production	mt	150.1	153.4	152.6	151.8
Dairy cows	m	25.4	24.5	22.7	21.2
Yield/cow	t	5.9	6.3	6.7	7.2
Price	€/100kg	27.4	29.3	30.6	31.5
Butter					
Production	mt	2.14	2.13	2.08	2.04
Domestic use	mt	2.09	2.12	2.13	2.14
Price	€/100kg	348	341	355	370
SMP					
Production	mt	1.17	1.29	1.20	1.12
Domestic use	mt	0.87	0.81	0.80	0.82
Price	€/100kg	203	230	230	224
WMP					
Production	mt	0.83	0.85	0.80	0.74
Domestic use	mt	0.51	0.54	0.58	0.63
Price	€/100kg	245	265	270	272
Cheese					
Production	mt	8.96	9.46	9.63	9.77
Domestic use	mt	8.28	8.63	9.02	9.43
Price	€/100kg	439	457	494	525

Source: AGMEMOD Model 2008

The overall level of EU dairy product consumption is projected to increase over the baseline projection period. Increases in EU domestic use reflect further growth in per capita consumption driven by real income growth, evolving consumer preferences for high value added products and modest EU population growth. The area of strongest consumption growth will be for cheese and fresh dairy products, whereas in general, consumption of more basic traditional products, like butter, is projected to decline.

Significantly, the reduced level of support for the EU dairy sector (intervention price reductions under Agenda 2000, the Mid Term review and tighter management of EU dairy export subsidy expenditure) had been anticipated to lead to lower EU dairy commodity and farm gate milk prices in the latter part of the current decade.

However, while prices did decline in 2006, the subsequent improvement in global market conditions in 2007 and 2008 has intervened to counteract the impact of the reduced levels of support. Nevertheless,

it can be expected that when international prices decline through 2008 and into 2009, the impact of reduced supports will have consequences for EU dairy commodity prices.

On average relative to 2005 and 2006, at an EU level, all dairy product prices increase in the Baseline projection period, with the largest increases for SMP, followed by WMP, both aided by positive world market developments. Increases in cheese prices are more modest due to increased production which tracks closely the increase in domestic consumption as investment in butter production in the EU is seen as unattractive.

In summary, the medium term milk price outlook across the various MS is relatively positive compared with what might have been projected two years ago.

However, it should be noted that, over the medium term, the dairy producer cost environment is projected to be less benign than previously considered, so it would be incorrect to interpret the improved producer milk price outlook as a windfall increase in dairy farm margins.

B. Scenarios

Table 4 presents the projected change in milk production by 2020 under the various scenarios relative to the Baseline outcome in 2020. Developments in milk production across the MS differ across the scenarios. Due to intervention price cuts under recent CAP reforms, the milk quota rents are generally small to begin with in many MS.

Despite projected technical progress in dairy production, these rents are projected to decline over time, consumed by the elevated cost of feed and the decline in milk price from the 2007 / 2008 price level.

It is important to realise that the vastly differing scale of milk production across the individual MS (ranging from less than 1 million tonnes in several MS to 28 million tonnes in Germany) means that the individual contribution of MS to the change in overall EU milk production can vary considerably in absolute terms. This means that caution is required in drawing conclusions based on a reading of the percentage changes in production in various MS.

Table 4: Change in EU production and price under Scenarios (relative to the Baseline)

	Milk1	Milk 2	Milk 3	Milk 4
Milk				
Production	4.8	4.8	4.3	3.7
Price	-7.1	-7.2	-8.0	-9.0
Butter				
Production	7.4	7.4	5.5	4.4
Consumption	2.4	2.5	3.2	3.8
Price	-9.9	-9.9	-12.8	-14.8
SMP				
Production	13.8	13.8	11.6	10.6
Consumption	7.8	7.8	6.9	6.5
Price	-5.7	-5.7	-4.9	-4.8
WMP				
Production	6.4	6.4	5.5	4.6
Consumption	-0.4	-0.4	-0.3	-0.3
Price	-6.7	-6.7	-6.7	-6.9
Cheese				
Production	5.0	5.0	4.7	4.2
Consumption	1.6	1.6	1.6	1.7
Price	-9.0	-9.1	-9.3	-10.4

Source: AGMEMOD Model 2008

The analysis suggests that at an EU level there is little to choose between the milk quota elimination scenarios in that they tend to lead to similar market outcomes at the EU level by 2020. An interesting outcome of the scenario analysis is that there is a reorientation of milk production between the various EU MS more so than there being any radical change in production. By way of illustration the EU is subdivide into 5 geographic regional groupings:

- Nordic: Estonia, Finland, Latvia, Lithuania and Sweden;
- Western: Belgium-Luxembourg, Denmark, Ireland, France, the Netherlands, United Kingdom;
- Mid-East: Czech Republic, Germany, Hungary, Poland, Slovak Republic;
- Alpine-Balkan: Austria, Bulgaria, Romania, Slovenia;
- Southern: Greece, Italy, Portugal, Spain.

Table 5 provides a regional summary of the change in milk production in the year 2020 under the four scenarios.

Table 5: EU Milk Production in 2020 relative to the
Baseline in 2020 under each scenario

% of EU27 production in 2005		Scenario 2020 % change relative to Baseline 2020			
		Milk 1	Milk 2	Milk 3	Milk 4
Nordic	6	2.4	2.4	1.6	0.9
Western	42	5.4	5..4	5.4.	4.6
Mid-East	31	5.3	5.3	4.8	4.3
Alpine-Balkan	8	-2.5	-2.6	-2.6	-2.7
South	13	6.9	6.9	6.3	5.5
EU15	81	5.4	5.4	4.9	4.3
EU12	9	3..9	3.9	3.3	2.5
EU27	100	4.8	4.8	4.3	3.7

Source: AGMEMOD Model 2008

It is notable that the rate of growth in the Western, Mid-East and South regions is greater than in the Nordic region. The Western and Mid-East regions are the regions with the greatest absolute production growth. The only region where production contracts, is in the case of the Alpine-Balkan region.

Further, note that the results for the South region are strongly conditioned by the positive growth in production in Spain. Since higher feed cost might play a bigger role than considered in the model for Spain, this outcome may need further consideration. If a greater impact of higher feed prices is assumed, then this would lead to a lower production increase.

At an EU aggregate level, the Scenarios generally reflect the trends in dairy product mix observed in the Baseline, i.e. expansion in cheese production and contraction in production of the intervention products.

However, in MS where expansion in milk production is significant, expansion in the production of all the modelled dairy products can be observed.

In general, butter prices are subject to the largest change at an EU level. By 2020, butter prices decline by 9% to 14% under the various scenarios, relative to the 2020 baseline. Fat is relatively abundant on the world market compared with protein, thus making it more difficult to find export opportunities for butter.

The EU's continuing structural surplus in milk fat is partially addressed through increased cheese production, which to a degree, negatively impacts on cheese prices. Conversion of protein into SMP and WMP becomes more limited. The production relativities between these two powder products in the

manufacturing sector are determined by the world market. The increase in production of other fresh products is projected to be limited. Such products are predominantly produced for domestic EU consumption. Increased production must be absorbed on the EU market and this results in a price decline, which then limits further expansion in production.

VI. CONCLUSIONS

To model milk quota abolition and the transition period thereafter, the dairy extension of AGMEMOD Version 2.0 is well developed and allows for a variety of simulations. Nevertheless, several caveats in the approach need mention:

Parameters applied in the PE model were, in most cases, estimated for a period in which a quota regime was applied, thus most parameters reflect a more restricted situation than might prevail under quota abolition scenarios. Furthermore, the econometric approach implicitly allows historical relationships to drive future projections e.g. shift away from butter to cheese processing due to concerns for cuts in intervention prices will be projected into the future. As the supply functions by contrast with other functions are synthetically established and the underlying rents are not estimated, some distortions might be projected into the future. Additionally, only limited knowledge concerning how technical progress can affect the actual cost is available.

In spite of the foregoing, these results are mostly in line with other earlier studies, if one takes into consideration that the world market situation has fundamentally changed in the last two years. Thus, external factors relating to global supply and demand for dairy products (as reflected in the Baseline) are a more important determinant of the future level of EU dairy product prices, milk prices and dairy production than are the changes in the milk quota regime which are examined.

Under the scenarios this change in product mix observed in the baseline is also a feature, but in addition some of the additional milk that is produced is channelled to all the major products.

The outcome under the milk quota expansion/elimination scenarios leads to conclusions which are broadly the same for these policy options.

EU dairy production increases relative to the baseline by between 3.7% and 4.8% and there is a reduction in the EU milk price of between 5% and 8% as a result. This outcome is the sum of both increases and decreases in individual MS level milk production.

EU MS can be categorised in accordance with the extent of the production increases (decreases) that are observed. Grass based dairy producers, with high initial quota rents, are best placed to expand milk production under quota expansion and elimination. High feed prices drive rents to zero relatively quickly in MS with low initial rents and where grain feeding is the dominant production system. Few countries exploit the full extend of the quota increase available to them in the phase out period, suggesting that the quota expansion allowed under the Milk 1 and Milk 3 scenarios is sufficient for most MS and a "hard landing" at EU level is avoided. A few MS continue to increase milk production once quotas are removed even under the Milk2 and Milk 4 scenario and there is merit in considering larger quota increases for these MS, particularly given that their contribution to overall EU milk production is small. This would avoid large production increases at the point where milk quotas are removed, which could otherwise have negative consequences for the sector in these MS over the short term.

The consequences of milk quota removal for other agricultural sector are minimal. There are projected to be more dairy cows (than in the baseline), but this is offset through a reduction in the number of beef cows, so the net change in the total number of cattle is small relative to the Baseline. Hence the consequences of the scenarios for the derived demand for feed are trivial.

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- Author: Trevor Donnellan
- Institute: Rural Economy Research Centre, Teagasc
- Street: Athenry
- City: Co Galway
- Country: Ireland
- Email: Trevor.donnellan@teagasc.ie